Deeper Regional Integration and Global Value Chains

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Recently, international trade has become regional rather than global. This study aims to test if deep regional integration contributes to the organization of global value chains centered around the regional clusters. We use data on not only trade in value added but also global value chain participation indexes that reflect the global value chains better than domestic value added in exported goods and services. Estimation results reveal that a deep regional trade agreement (RTA) has heterogeneous effects on global value chains depending on the regional clusters. In particular, Asia imports more intermediate goods than Europe and America, while RTA member countries tend to import more intermediate goods from Europe than Asia and America.

Keywords: Global value chains, Deeper integration, Regional clusters

JEL Classification: F11, F14

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I. Introduction

Since the Trump administration, the US has used bilateral trade actions as its leverage and simultaneously pursued regional trade negotiations with strategic partners. The United States has bilaterally imposed tariffs on steel and aluminum imports under Section 232 of the 1962 Trade Expansion Act and investigated whether automotive product imports have violated US national security. The US Trade Representative increased tariffs on Chinese products under Section 301 of the Trade Act of 1974, claiming that China, as a non-market economy, has stolen valuable US intellectual property rights (IPR) and accumulated a considerable trade surplus.

Meanwhile, the United States revised the North American Free Trade Agreement (NAFTA) and Korea–United States Free Trade Agreement, stating that they were outdated and imbalanced. Notably, the United States–Mexico–Canada Agreement (USMCA) upgrades key NAFTA obligations by including strong provisions on rules of origin, IPR, digital trade, labor, and the environment. In addition, the US announced its plans to pursue new trade deals with strategic partners, including the European Union, Japan, and the United Kingdom. The 2019 US Trade Agenda publicized that the United States would address tariff and non-tariff barriers through the new trade deals, thereby pursuing deeper trade and investment relationships.

The European Union finalized the EU-Japan Economic Partnership Agreement in 2017. The EU also agreed to resume trade agreement negotiations with the United States after they failed to find a compromise for the so-called Transatlantic Trade and Investment Partnership. Japan played a leading role in finalizing the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which entered into force in December 2018. The CPTPP aims to form Trans-Pacific value chains by introducing cumulative rules of origin and improving the trade rules on trade facilitation, state trading, government procurement, and IPR, among others. The CPTPP member countries reached a compromise between conflicting opinions to strengthen the regional integration on the verge of collapse after the decision of the US to withdraw from the CPTPP. Countries including China, Japan, India, Korea, Australia, New Zealand, and ASEAN members finalized trade negotiations for the Regional Comprehensive Economic Partnership (RCEP) in 2019 to attain progressive and gradual liberalization for

various issues related to economic development situations.

These changes in international trade negotiations have many implications for the global trading system, including the following examples. First, major developed countries including the US, the EU, and Japan have focused on bilateral and regional trade deals rather than resorting to multilateral trading regimes. The multilateral trade round of the Doha Development Agenda is still incomplete after 18 years of negotiations, mainly because of the power shift from the previous quad (the US, EU, Japan, and Canada) to the new G7 of the US (the EU, China, India, Brazil, Japan, and Australia). Hence, the multilateral trading system has not dealt effectively with the ever-increasing 21st century trade issues related to environmental protection, digital trade, and IPR.

Second, mega FTAs, such as the USMCA, CPTPP, EU–Japan FTA, and RCEP, are expected to consolidate global value chains that have emerged as new platforms for national development strategies. Since the 1990s, China has become the world's factory, surpassing the US and the European economies in terms of trade values. The US–EU FTA and US–Japan FTA will possibly strengthen their pivotal roles as the regional hubs in production networks are finalized in the future.

Third, recent trade agreements have deepened regional integration by improving trade rules already covered and including new rules which are not addressed in the WTO agreements. The recent trade agreements may serve as stepping stones for multilateral agreements in that they are complementary to the traditional rule-making. Moreover, many countries have negotiated FTAs to attain deep regional integration by going beyond traditional trade negotiation issues.

Previous literature including Boffa *et al.* (2019), Laget *et al.* (2018), Ruta (2017), Orefice and Rocha (2014), and Antras and Staiger (2012) emphasized the importance of deep regional integration for global value chains. In particular, Laget *et al.* (2018), Ruta (2017), and Orefice and Rocha (2014) investigated the relationship between deep regional trade agreements (RTAs) and global value chains using the database on the contents of preferential trade agreements (PTAs) created by the World Bank.

Laget *et al.* (2018) estimated structural gravity equations using data on trade in value added (TiVA) and intermediate trade from 1995 to 2011. They analyzed the impacts of deep trade agreements on economic integration in global value chains and elucidated the importance of specific elements in PTAs. Their estimation results indicated the role of deep trade agreements during the integration among countries with

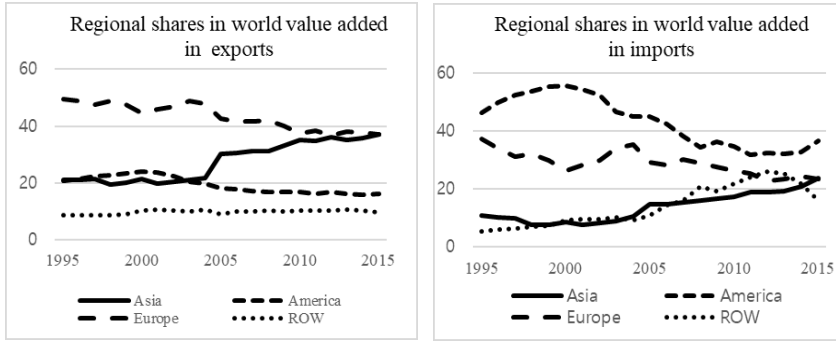
different development stages. Ruta (2017) applied a gravity model to the World Bank database and on the data on TiVA by treating the existence of trade agreement as a dummy variable. This study investigated the factors of PTAs in global value chains and tested if the PTA increases the integration of global value chains. Moreover, this study analyzed the effects of the PTA contents on the trade in global value chains and how global value chains affect the choices of PTA partners. Results show that global value chains require deep RTAs to function smoothly and reduce the cost of coordinating and harmonizing policies. Orefice and Rocha (2014) applied a time-series methodology to the WTO database on PTAs from 1980 to 2007 using the methodologies developed by Horn (2010). The research investigated the impacts of deep regional economic integration on production networks and tested if a higher probability of deep trade agreements occurred in the production networks between developed and developing countries.

Previous studies have investigated the relationship between deep regional integration and global value chains, but the regional perspective of global value chains has been neglected. Previous literature analyzed the effects of regional integration on globalization by economic development stages, namely, the effects of the integration between developed and developed countries, developed and developing countries, and developing and developing countries. However, this approach does not detect the relationship between RTAs and the organization of value chains centered around regional clusters such as the US, the EU, and China. Recently, all production stages from the conception of a product to the final consumption and afterward have been geographically distributed worldwide. In particular, global value chains have proliferated due to various reasons including global trade and investment liberalization, wage gaps between developed and developing countries, and information and communication technologies. Specifically, dramatic production fragmentation has arisen in the Asian region. For example, Kimura (2013) confirmed that the Asian share of trade in intermediate goods has been dominant compared with those of Europe, America, and the rest of the world. OECD (2017b) also revealed that production has become increasingly concentrated in regional hubs which are closer to the final goods markets.[1]

[1] OECD (2017b) indicated that companies are increasingly changing their

Baldwin (2013) indicated that Asia's participation in global value chains suddenly rose as the ICT revolution took off around 1990 and surpassed North America and Europe by the late 1990s.[2] Baldwin (2013) suggested that deep trade agreements have boosted global value chains because the international trade in global value chains was regional rather than multilateral.[3] The Asian share in world value added in exports and imports increased substantially between 1995 and 2015 as shown in Figure 1. The data also reveal that the American and the European shares in world value added in exports decreased steadily but their shares in imports still remained high during the same period.

Diakantoni *et al.* (2017) and WTO and IDE-JETRO (2011) indicated that regional hubs, such as the US for America, Germany for Europe,



Source: Author's calculation using TiVA database.

Figure 1
Regional Shares in World Value Added in Exports and Imports (%)

sourcing strategies by localizing their production. Refer to OECD (2017b), p.17.

[2] Baldwin (2013) proposed that one measure of supply chain internationalization focuses on products exported and imported by nations at extraordinary amounts. This study revealed that "before the ICT revolution, most of the international sourcing was done among mature economies, such as the United States and Canada, in the auto industry or as in intra-EU trade in machinery." Refer to Baldwin (2013), pp.17-19.

[3] Baldwin (2013) stated that the GATT rules were insufficient for the cross-border relations, and the deep disciplines were placed in regional trade agreements. Refer to Baldwin (2013), p.40.

and China for East Asia, have played a central role in global value chain trade.[4] The three regional clusters are the major designers of mega FTAs such as the USMCA, EU-Japan FTA, CPTPP, and RCEP. Furthermore, the US announced that formal negotiations will be launched for a new RTA with the EU. The US also made it public that it would renegotiate with the CPTPP member countries if the CPTPP would reflect the US' concerns.

In this context, this study aims to test if deep regional integration contributes to the organization of global value chains including that of the US, the EU, and China. We also investigate the implications of mega FTAs for global value chains. We estimate the extent of the difference in the effects of the depths of the RTAs on the value chains by region, thereby investigating how countries use the foreign intermediate parts and components for their exports.

Orefice and Rocha (2014) investigated the effect of deep integration on production networks using the log bilateral imports in parts and components. However, the gross trade data have the problem of double counting because cross border numbers were not considered and the value added in re-export and re-import was not captured. Koopman, Wang, and Wei (2014) and Wang, Wei, and Zhu (2016) decomposed the gross exports into various components including domestic and foreign value added of exported goods and services and domestic value added of intermediates re-exported to third countries. The OECD (2012) proposed a participation index using the data on domestic value added of intermediates re-exported to third countries, foreign value added of goods and services exports, and gross exports. Kummritz *et al.* (2016) calculated forward and backward global value chain integration by measuring foreign value added in exports and domestic value added re-exported by third countries, respectively. We use data on TiVA and global value chain participation indexes that reflect the global value chains better than the domestic value added of exported goods and services.

The rest of this paper is organized as follows. Section II discusses how we obtained the data on the depth of regional integration. Section III describes the empirical model and data used in this study. Section

[4] Diakantoni *et al.* (2017) stated that, "the East Asia and Europe regional value-chains include several smaller clusters organized around, for example, Japan or the UK." Refer to Diakantoni *et al.* (2017), p. 27.

IV presents the estimation results and robustness checks. Section V concludes.

II. Content of PTAs

In this study, we use the World Bank database on the content of PTAs. Our study contains data on 189 countries from 1958 to 2015, covering 52 provisions in 279 PTAs notified at the WTO. Horn *et al.* (2010) divided these provisions into the two groups of WTO-plus (WTO+) and WTO-extra (WTO-X).[5] The first group represents the 14 provisions discussed by the current mandate of the WTO and upgraded by the PTA partners beyond their multilateral commitments. These WTO-plus provisions are related to the following: FTA industrial and agricultural goods, customs, export taxes, *sanitary and phyto-sanitary (SPS)* measures, technical barriers to trade (TBT), state trading enterprise, anti-dumping, countervailing measures, state aid, public procurement, trade-related investment measures (TRIMs), general agreement on trade in services (GATS), and trade-related intellectual properties (TRIPs).

The second group represents the 38 provisions included in the PTAs outside the WTO commitments. These WTO-X provisions cover the following areas: anti-corruption, competition policy, environmental laws, IPR, investment, labor market regulation, capital movement, agriculture, political dialogue, public administration, health, human rights, approximation of legislation, financial assistance, innovation policies, cultural cooperation, energy, illicit drugs, audiovisual, civil protection, industrial cooperation, information society, consumer and data protection, economic policy dialogue, education and training, mining, illegal immigration, regional cooperation, research and technology, money laundering, nuclear safety, small- and medium-sized enterprises, statistics, social matters, taxation, terrorism, and visa and asylum issues.

The World Bank database on the content of PTAs also includes information on the legal enforceability according to texts that specify clear legal obligations and which are more likely to be implemented

[5] Horn *et al.* (2010) explained the two conflicting reasons why WTO members include WTO-X provisions as follows: First, "PTAs serve as a kind of preparation for setting tomorrow's multilateral agenda." Second, the PTA partners do not want to include certain provisions in the WTO. Refer to Horn *et al.* (2010), p.1567.

than less clearly and definitely expressed counterparts.[6] If we apply the criteria of legal enforceability to WTO+ and WTO-X, then we can classify the PTA provisions into four categories as follows: legally non-enforceable WTO+, legally enforceable WTO+, legally non-enforceable WTO-X, and legally enforceable WTO-X.

Table 1 indicates that the PTAs include more WTO+ provisions than WTO-X provisions. The average number of total WTO+ and WTO-X provisions from 1970 to 1979 is 16.8 and 7.3, respectively, which went up to 32.3 and 20.0 from 2010 to 2015, respectively. Thus, the average number of total WTO-X provisions grew faster than that of WTO+ provisions during the same period. As for the average number of legally enforceable provisions, these numbers have nearly tripled from 1970 to 2015, whereas the average number of legally non-enforceable provisions doubled during the same period.

In particular, the depth of RTAs is outstanding in the area of legally enforceable WTO plus provisions. In comparing the content of PTAs across different country groups such as developed–developed, developing–developed, and developing–developing, Orefice and Rocha (2014) found that

Table 1
Trend of WTO+ and WTO-X in Terms of Legal Enforceability

	Legally non-enforceable WTO+	Legally enforceable WTO+	Legally non-enforceable WTO-X	Legally enforceable WTO-X	Legally non-enforceable provisions	Legally enforceable provisions
1970–1979	6.3	10.5	5.3	2.0	11.7	12.5
1980–1989	7.7	12.7	4.3	2.7	12.0	15.3
1990–1999	6.6	11.7	4.6	5.5	11.2	17.2
2000–2009	10.6	18.2	8.4	6.9	19.0	25.0
2010–2015	11.6	20.7	10.6	9.4	22.2	30.1

Source: Author's calculation using the World Bank database.
Note: Numbers in the table denote the average number of provisions per PTA during the corresponding period.

[6] Horn *et al.* (2010) noted that, "the implementation of PTAs should not be taken for granted." Refer to Horn *et al.* (2010), p.1598.

TABLE 2
CONTENT OF PTA PROVISIONS BY AREA

Area of contracting party	Area of partner country	Legally non-enforceable WTO+	Legally enforceable WTO+	Legally non-enforceable WTO-X	Legally enforceable WTO-X	Legally non-enforceable provisions	Legally enforceable provisions
America	America	11.9	22.6	8.7	9.2	20.6	31.8
America	Asia	12.0	22.3	11.0	8.7	23.0	30.9
America	Europe	12.2	20.2	24.2	7.6	36.4	27.8
America	The rest of the world	11.6	18.5	3.0	3.1	14.5	21.6
Asia	Asia	5.1	9.3	3.0	3.1	8.0	12.3
Asia	Europe	12.6	23.0	7.5	9.7	20.1	32.7
Asia	The rest of the world	10.0	16.5	5.0	6.0	15.0	22.5
Europe	Europe	12.3	24.2	16.8	32.8	29.1	57.1
Europe	The rest of the world	10.9	17.9	16.2	6.9	27.1	24.8
The rest of the world	The rest of the world	6.1	10.0	1.9	2.3	8.0	12.3

Source: Author's calculation using the World Bank Database.

Note: Numbers in the table denote the average number of provisions per PTA between the areas where the two contracting parties belong.

agreements between developed and developed countries include a higher number of WTO+ provisions compared with other agreements. In this study, we compare the content of PTAs across areas such as America–Asia, Asia–Europe, and Europe–the rest of the world, for example. Table 2 shows how the PTA contents are substantially different depending on the area where the two contracting parties belong.

III. Data and Empirical Model

A. Depth of RTA

Previous studies on bilateral trade flows have been conducted using a binary variable to represent the presence or absence of a free trade agreement. However, the present study investigates the impacts of deep regional integration on global value chains using the new database developed by the World Bank.

We created a new database using the information on the depth of RTA according to legal enforceability, as discussed in the previous section. The depth of RTA depends upon the legal enforceability whether the provisions are discussed by the current mandate of the WTO or they are outside the WTO commitments. This outcome is because deep RTAs can be attained only based on legal mechanisms to punish any violation of the commitments by FTA signatories.

Including the 52 provisions in the estimation equation will lead to severe multi-collinearity. Thus, we will count the total number of enforceable provisions contained in each RTA. The World Bank database assigns a number of 0 if the provision is not mentioned in the agreement or not legally enforceable, 1 if the provision is mentioned and legally enforceable but explicitly excluded by dispute settlement provision, and 2 if the provision is mentioned and legally enforceable.[7]

The first measure of the depth of a RTA is the number of all legally enforceable provisions (*number_prov*). Nevertheless, this measure does not efficiently represent the depth of RTA because it does not reflect the differential influence of each provision.

The second measure uses the principal component analysis, which converts a set of possibly correlated variables into a set of linearly uncorrelated ones. Doing so reduces the dimension of the variables by decomposing the eigenvalue. The 52 provisions contained in the RTAs seem to be correlated with one another. For example, the provision of tariff liberalization on industrial goods is highly correlated with the provisions concerning the elimination of export taxes and customs information. This work employed the first principal component analysis and generated a measure composed of nine provisions (*PCA_9*) with the

[7] For a detailed description of PTA's provisions, refer to https://datacatalog.worldbank.org/dataset/content-deep-trade-agreements.

highest factor loading which are related to global value chains.[8] The following are included: SPS, TBT, state trade enterprises, anti-dumping duties, state aid, public procurement, TRIMs, GATS, environmental laws, and labor market regulation.

B. Measuring Global Value Chains

No agreement was held on how to measure global value chains. For example, Orefice and Rocha (2014) and Ferrantino (2019) used bilateral trade data in parts and component measures. In addition, and Laget *et al.* (2018) utilized domestic value added in exports and value added in intermediates to capture the intensity of the global value chain relationships between the two countries. However, bilateral trade data are not an appropriate measure as double counting in gross trade data has become more pervasive today than in the past, thereby resulting in falling value added in exports relative to gross exports (Johnson and Noguera 2017).

This study uses forward and backward participation indexes in global value chains. First, forward participation in global value chains is defined to be the domestic value added embodied in foreign exports, namely, domestic imports. The index is calculated by dividing the domestic value added in foreign exports by the total gross exports of the partner country as follows (OECD 2012; OECD 2017a):

$$Part\_forward_{klt} = \frac{Domestic\ Value\ Added\ in\ Import_{klt}}{Gross\ Export_{lt}}. \qquad (1)$$

Second, backward participation in global value chains is defined as the foreign value added embodied in exports. The index is calculated by dividing the foreign value added in exports by the total gross exports as follows:

$$Part\_backward_{klt} = \frac{Foreign\ Value\ Added\ in\ Export_{klt}}{Gross\ Export_{kt}}. \qquad (2)$$

[8] Orefice and Rocha (2014) excluded the provisions related to health, cultural cooperation, and social matters among others because they might not have any specific relations with production networks. See Orefice and Rocha (2014), p.112.

This study also uses the domestic value added in imports (*imp_dva*) along with the gross imports in intermediate goods (*imp_int*) to capture the trade in global value added.

C. Multilateral Resistance

Baier and Bergstrand (2009) and Baier *et al.* (2014) considered the relative trade costs from the rest of the world and the bilateral trade costs in estimating a gravity equation. To obtain the efficient estimates of gravity variables, this research accounts for the multilateral resistance (*MR*) suggested by Baier and Bergstrand (2009) and Bair *et al.* (2014), as follows.[9]

$$M_{dist\_kl} = \frac{1}{2N}(\Sigma_{i\neq l}^{N} dist_{ki} + \Sigma_{i\neq t}^{N} dist_{li}), \tag{3}$$

$$M_{contig\_kl} = \frac{1}{2N}(\Sigma_{i\neq l}^{N} contig_{ki} + \Sigma_{i\neq t}^{N} contig_{li}), \tag{4}$$

where N represents the number of countries.

D. Empirical Model

We estimate the effects of the depth of RTAs on global value chains. Osnago *et al.* (2015) applied the panel data methodology to investigate the determinants of foreign direct investment by dealing with independent variables, such as an RTA dummy, the number of PTA provisions, and the five provisions of TRIPs, IPR, countervailing measures, state trade, and capital movement. Orefice and Rocha (2014) used the gross imports and depth of PTAs as dependent and independent variables, respectively. Boffa *et al.* (2019) estimated the effect of trade agreements and bilateral investment treaties on TiVA using a gravity model in logarithms.

This study uses various measures of global value chains and the depth of RTAs by applying the following estimation model:

[9] Baier *et al.* (2014), pp.38-41.

$$GVC_{klt} = \alpha_0 + \beta_1 RTA_{klt} + \beta_2 BIT_{klt} + \beta_3 Depth_{klt} + \Gamma X_{kl} + \delta_{kl} + \delta_{kt} + \delta_{lt} + \varepsilon_{klt}, \quad (5)$$

where *GVC* is a measure of global value chains between the two countries, *k* and *l* represent country *k* and *l*, and *t* represents time *t*. *RTA* and *BIT* are the dummy variables to control for the RTA and the bilateral investment in force.[10] *Depth* represents the depth of RTA. We included the *RTA* dummy to represent a shallow RTA with average depth and *Depth* for the deeper RTA. *X* is the variable indicating the distance between the two countries (*dist*). We also indicate whether 9% or more of the population in both countries speak a common language (*comlang*), and whether they are contiguous (*contig*) and have ever had a colonial link (*colony*). To address the concern of unobserved country-pair heterogeneity, we included country-pair fixed effects (δ_{kl}). We also included time-varying exporter fixed effects (δ_{kt}) and time-varying importer fixed effects (δ_{lt}), which account for time variant differences across countries.

We investigated the effect of deep regional integration on global value chains by a regional group including Asia (*Asia*), America (*America*), Europe (*Europe*), and the rest of the world (*ROW*). We also analyzed the impact of a mega RTA such as the *CPTPP*, the *RCEP*, and a prospective TPP (*USTPP*) which will be possibly launched by the US joining the CPTPP in the future.

The gravity equation is subject to endogeneity bias because an FTA policy is not an exogenous variable, as Baier and Bergstrand (2007) indicated.11 Some of the observations in the data set of this study are missing or have the values of 0.[12] In addition, the gravity variables do not capture all the country-pair fixed effects efficiently. Thus, we estimate the following equation that deals with a Poisson pseudo-

[10] Boffa *et al.* (2019) stated that BITs and deep RTAs have a heterogeneous impact on GVCs because "BITs deal exclusively with investment protection," whereas "deep RTAs introduce commitments that span beyond investment." pp.1713-1714.

[11] Baier and Bergstrand (2007) recommended the implementation of panel data with bilateral fixed and country-and-time effects. See Baier and Bergstrand (2007), p.74.

[12] For example, 8.8% and 10.7% of data on forward and backward participation indexes have zero values, respectively, and 25.8% of data on PCA-9 have zero values.

maximum likelihood estimator which is consistent in the presence of country-pair and year fixed effects (Silva and Tenreyro 2006; Miroudot 2016).

$$GVC_{klt} = \alpha_0 + \beta_1 RTA_{klt} + \beta_2 BIT_{klt} + \beta_3 Depth_{klt} + \delta_{kl} + \delta_{kt} + \delta_{lt} + \varepsilon_{klt}, \quad (6)$$

where *GVC* is a measure of global value chains between the two countries; *k* and *l* represent country *k* and *l*, respectively; and *t* represents time *t*.

In this study, we used the database on TiVA from 1995 to 2015 released by the OECD. The 2016 edition of the TiVA database covers

Table 3
Summary of Statistics

Variable	No. of obs.	Mean	Standard deviation	Minimum	Maximum
part_forward	86,080	0.30	0.62	0.00	10.70
part_backward	86,080	0.39	1.01	0.00	21.80
log(imp_dva)	44,118	1.21	2.48	–2.30	10.49
log(imp_int)	82,143	4.19	2.56	–4.61	11.38
RTA	86,080	0.09	0.29	0.00	1.00
BIT	86,080	0.29	0.45	0.00	1.00
PCA_9	86,080	0.49	1.03	0.00	3.08
number_prov	86,080	0.11	0.22	0.00	0.72
log(dist)	83,412	8.48	1.02	4.09	9.89
contig	83,412	0.03	0.18	0.00	1.00
comlang	83,412	0.08	0.28	0.00	1.00
log(m_dist)	83,412	9.20	0.17	8.97	9.74
m_contig	83,412	0.03	0.01	0.00	0.09
Asia	86,080	0.25	0.43	0.00	1.00
America	86,080	0.14	0.35	0.00	1.00
Europe	86,080	0.48	0.50	0.00	1.00
Rest of the World	86,080	0.12	0.32	0.00	1.00

Source: Author's calculation.
Note: The sample period is 1995–2015.

64 countries and 34 industries, whereas the 2018 edition includes 69 economies and 36 industries. To measure the depth of RTAs, we employed the World Bank database on the content of deep trade agreements. This study utilized the UNCTAD database on international investment agreements, which reports the signatories, date of signatures, status, and text. The database covers 2,571 investment treaties (*BIT*) from 1959 to 2016. We also used the CEPII database on geographical variables including *dist*, *comlang*, *contig*, and *colony*. For this research, we classified economies into 64 countries and industries into 34 sectors as covered by the 2016 edition of the TiVA database (Appendix).

IV. Estimation Results

A. Impacts of Deep Regional Integration on Global Value Chains

The second unbundling of production stages creates new issues of connectivity across borders, thereby generating demand for deeper forms of regional integration.[13] To investigate the relationship between deep RTA and global value chains, we estimated Eqs. (1) and (2) using a Poisson estimation methodology. Table 4 shows the empirical estimation results. The dependent variables are forward and backward participation indexes in global value chains at the country level.

All empirical models included country-pair and country-year fixed effects to account for the unobserved factors. The comparison between Columns 1 through 3 using the forward participation index as a dependent variable reveals that the estimates of β in all empirical specifications are positive and statistically significant. The estimation result reveals that an RTA of average depth (*RTA*) seems to have a greater impact on forward participation in global value chains than the depth of RTAs (*PCA_9*). However, we cannot compare the magnitudes of the parameter estimates for *RTA* and *PCA_9* because *RTA* is a dichotomous variable, and *PCA_9* is an index calculated from the first principal components. The parameter for *BIT* is positive and statistically significant.

[13] Ruta (2017) asserted that global value chains create new rationale for PTAs, as the unbundling of production stages creates new forms of international policy spillovers and time-consistency problems. See Ruta (2017), p.16.

Table 4
Deep Regional Agreements and GVC Participation Index

Dependent Variable	Part_forward			Part_backward		
RTA	0.15 (0.05)a		0.14 (0.05)a	–0.01 (0.05)		–0.02 (0.05)
BIT		0.11 (0.04)a	0.11 (0.04)a		0.11 (0.04)a	0.11 (0.04)a
PCA_9	0.06 (0.01)a	0.06 (0.01)a	0.06 (0.01)a	0.01 (0.01)	0.02 (0.01)	0.02 (0.01)
constant	–1.33 (0.06)a	–1.35 (0.06)a	–1.36 (0.06)a	–1.39 (0.07)a	–1.42 (0.07)a	–1.42 (0.07)a
country-pair	Yes	Yes	Yes	Yes	Yes	Yes
country_year	Yes	Yes	Yes	Yes	Yes	Yes
No. obs	86,080	86,080	86,080	86,080	86,080	86,080
log-likelihood	–39,430	–39,430	–39,426	–41,875	–41,871	–41,871

Source: Author's calculation.
Note: Standard errors are reported in parentheses. The "a" and "b" here denote significance at the 1% and 5% levels, respectively.

Columns 4 through 6 deal with the backward participation index as a dependent variable. The sign for the parameter of the depth of RTA (PCA_9) is positive as expected but is statistically insignificant. The sign for the bilateral investment treaty (*BIT*) is positive and statistically significant. The sign for the parameter of *RTA* is negative and statistically insignificant.

Thus, *BIT* and deep regional integration (PCA_9) have played important roles in importing foreign intermediate goods for domestic exports of processed intermediate goods and final goods. Domestic imports of foreign intermediate goods for domestic exports are better explained by a BIT. This result is consistent with that of Boffa et al. (2019) in that BIT acts on backward linkages and thus on the use of foreign input.[14]

[14] Boffa *et al.* (2019) estimated the impacts of deep regional trade agreement, shallow regional trade agreement, and bilateral investment treaty separately. Their results indicate that deep regional trade agreements have a greater effect for global value chains than shallow regional trade agreements and bilateral investment treaties. See Boffa *et al.* (2019), pp.18-19.

Table 5
Gravity Approach for Relationship between Deep RTA and GVCs

Dependent Variable	Part_forward			Part_backward		
RTA	0.03 (0.05)	0.25 (0.05)a	0.12 (0.05)b	–0.12 (0.05)a	0.05 (0.05)	–0.03 (0.05)
BIT	0.21 (0.03)a	0.08 (0.04)b	0.11 (0.04)a	0.19 (0.03)a	0.12 (0.04)a	0.11 (0.04)a
PCA_9	0.04 (0.01)a	0.09 (0.01)a		0.00 (0.01)	0.03 (0.01)a	
number_prov			0.27 (0.05)a			0.07 (0.04)
log(dist)	–0.37 (0.02)a			–0.54 (0.02)a		
comlang	0.73 (0.08)a			0.86 (0.08)a		
contig	0.81 (0.12)a			0.67 (0.13)a		
colony	0.39 (0.13)a			0.59 (0.14)a		
log(m_dist)		0.63 (0.13)a			–0.48 (0.15)a	
m_contig		17.55 (1.44)a			12.32 (1.54)a	
constant	1.53 (0.21)a	–13.58 (2.60)a	–1.36 (0.06)a	2.71 (0.22)a	–1.15 (2.45)	–1.42 (0.07)a
country-pair	No	Yes	Yes	No	Yes	Yes
country_year	Yes	No	Yes	Yes	No	Yes
year	No	Yes	No	No	Yes	No
No. obs	83,412	83,412	86,080	83,412	83,412	86,080
log-likelihood	–36,728	–36,995	–39,429	–38,575	–39,009	–41,871

Source: Author's calculation.

Note: Standard errors are reported in parentheses. "a" and "b" denote significance at the 1% and 5% levels, respectively.

This work also tested a model specification using different estimation equations in Table 5. We included the gravity variables along with the multilateral resistance terms to control for their exporter-importer

fixed effects. The exporter–importer fixed effects are better controlled if multilateral resistance terms are included in the estimation equation. For the deep regional integration, we used the total number of legally enforceable provisions (*number_prov*) and the results from principal component analysis (*PCA_9*).

The estimates of β in all empirical specifications from Columns 1 through 3 are positive and statistically significant, thereby implying that the importance of deep regional integration is valid for forward participation in global value chains. The deeper regional integration is, the greater domestic value added is embodied in foreign exports. In other words, deep regional integration contributes to production fragmentation and offshoring activities, thereby being conducive to increase in trade in tasks. The parameter for the total number of legally enforceable provisions (*number_prov*) is positive and statistically significant.

Columns 4 to 6 show the different estimation results on backward participation in global value chains. The parameter estimate of the BIT has the expected sign with statistical significance, whereas that of *RTA* is mixed and statistically insignificant. The parameter for the depth of RTA is positive, and this outcome is consistent with our expectation, but the value is statistically insignificant. Thus, the foreign value added embodied in domestic exports is better explained by a BIT rather than by RTAs. Table 5 also indicates that the total number of legally enforceable provisions along with the PCA-9 index obtained by principal component analysis can explain the changes in global value chains. We used Eq. (2) including the country-pair and country-year fixed effects in the next section because the gravity approach does not capture all the country-pair fixed effects efficiently.

B. Tests of GVC Organization centered around the Regional Clusters

This study investigated the effect of deep regional integration on domestic value added embodied in foreign exports and foreign value added embodied in domestic exports. Thus, we estimated the effect of the depth of RTA on the forward and backward participation indexes. Specifically, this research includes the interaction terms of PCA_9 and regional dummies including *Asia*, *America*, and *Europe* to estimate additional regional impacts that are not captured by *PCA_9* (Table 6). We also estimated the additional effects of a RTA with a specific region as an RTA partner on the participation in global value chains using

interaction terms including *Asia_partner* PCA_9*, *America_partner* PCA_9*, and *Europe_partner* PCA_9*.

The estimation results on forward participation in global value chains (Columns 1 and 2 in Table 6) indicate that the impact of *PCA_9* on forward participation changes depending on the regional dummies.

Table 6
Effects of Deep Regional Integration on GVC Participation by Regional Cluster

Dependent Variable	Part_ forward	Part_ forward	Part_ backward	Part_ backward
RTA	0.15 (0.05)a	0.18 (0.05)a		
BIT	0.11 (0.04)a	0.11 (0.04)a	0.11 (0.04)a	0.11 (0.04)a
PCA_9	0.04 (0.09)	–0.37 (0.13)a	–0.13 (0.10)	–0.02 (0.08)
Asia*PCA_9	0.02 (0.10)		0.09 (0.11)	
America*PCA_9	0.10 (0.10)		0.12 (0.11)	
Europe*PCA_9	0.01 (0.09)		0.15 (0.10)	
Asia_partner*PCA_9		0.53 (0.14)a		–0.07 (0.08)
America_partner*PCA_9		0.44 (0.14)a		0.03 (0.08)
Europe_partner*PCA_9		0.42 (0.13)a		0.04 (0.08)
constant	–1.35 (0.06)a	–1.36 (0.06)a	–1.44 (0.07)a	–1.44 (0.07)a
country-pair	Yes	Yes	Yes	Yes
country_year	Yes	Yes	Yes	Yes
No. obs	86,080	86,080	86,080	86,080
log-likelihood	–39,420	–39,414	–41,868	–41,863

Source: Author's calculation.

Note: Standard errors are reported in parentheses. "a" and "b" denote significance at the 1% and 5% level, respectively.

The interaction terms of the regional dummy and depth of RTA are positive, as we expected. In particular, the parameter estimates on the interaction term of a specific region as the RTA partner and *PCA_9* are statistically significant.

Interestingly, the magnitudes of the parameter estimate differ depending on the region. This result implies that the deep RTA with the Asian partners has the greatest impact on the forward participation in global value chains, followed by the American partners and the European partners. Thus, if the RTA with the Asian partners is deep, then Asian exports use many intermediate goods of RTA member countries. In other words, the RTA member countries export more intermediate goods to the Asian RTA partner countries if the RTA contains deeper provisions. Such positive effects are optimal in the case of Asian countries including China whose industrial structures are export-oriented and who assembles the imported intermediate goods to export final goods to foreign countries.

Conversely, the estimation results on backward participation in global value chains (Columns 3 and 4 in Table 5) indicate that the interaction terms of the regional dummy and deep RTA are statistically insignificant. The backward participation in global value chains is better explained by the bilateral treaty investment rather than the RTA which is discussed in the previous section.

The results on the backward participation index[15] indicate that the magnitude of the parameter estimate is most outstanding in Europe, followed by in America and Asia. Therefore, if the RTA is deep, then the exports of RTA member countries embody the European intermediate goods. The coefficient for the interaction term of Asia as an RTA partner and *PCA_9* is negative but statistically insignificant.

C. Possible Impacts of Mega FTAs on Global Value Chains

We investigated the impacts of mega FTAs on global value chains. The CPTPP came into effect in December 2018 without the participation of the US. The US will reportedly join the CPTPP if its interests are reflected during the renegotiation processes. Currently, many discussions have been conducted about mega FTAs, such as the US–

[15] We did not include *RTA* as an independent variable in Columns 3 and 4 of Table 5 because its estimate is statistically insignificant.

EU FTA and RCEP. The US and the EU have just started to contact each other for formal negotiations, and China, Japan, Korea, India, Australia, New Zealand, and the ASEAN member countries have agreed to complete the RCEP negotiations in 2019.

This study assumed that the prospective mega FTAs will have the depth of RTAs in the same degree as previously attained by member countries. This work also estimated and compared the possible effect of such mega FTAs, including the CPTPP and RCEP, on the forward participation in global value chains by scenario. In addition, we analyzed the impacts from the scenario of the US possibly joining the CPTPP. Specifically, this study included the interaction terms of PCA_9 and RTA dummies such as CPTPP, USTPP, and RCEP to estimate the additional impacts of deep RTA on the global value chains which are not captured by PCA_9 (Table 7). We also estimated the additional impacts of a possible RTA on the participation in global value chains by an RTA partner (CPTPP_partner, USTPP_partner, and RCEP_partner).

The empirical results on PCA_9 are consistent with our expectation that the depth of mega RTAs will have positive effects on the forward participation in global value chains. If the US joins the CPTPP in the future, this development would have a positive impact on the forward participation in global value chains. The effect of the depth of CPTPP on forward participation is smaller than that of the USTPP, which is the US-joining scenario. Thus, if the deeper provisions are included in the USTPP, then more intermediate goods produced in USTPP member countries will be used for foreign exports.

The positive impact of the USTPP would be magnified because the US, Japan, and other members will possibly use the parts and components made in the member countries' customs territories to satisfy the cumulative rules of origin which were newly introduced in the CPTPP. The deep RCEP provisions will positively impact the forward participation in global value chains, but this result is statistically insignificant.

The parameter estimate for the interaction term of RCEP_partner*pca_9 is 0.10, a value that is statistically significant. In other words, the RCEP member countries tend to import foreign intermediate goods for their exports partly because the RCEP member countries are the export-oriented Asian countries. Conversely, the parameter estimates for CPTPP_partner and USTPP_partner are statistically insignificant.

Table 7
Impacts of Mega FTAs on Participation in Global Value Chains by Scenario

Dependent Variable: part_forward	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
RTA	0.15 (0.05)a	0.15 (0.05)a	0.14 (0.05)a	0.14 (0.05)a	0.14 (0.05)a	0.15 (0.05)a
BIT	0.10 (0.04)a	0.11 (0.04)a	0.11 (0.04)a	0.11 (0.04)a	0.11 (0.04)a	0.11 (0.04)a
PCA_9	0.05 (0.01)a	0.05 (0.01)a	0.06 (0.01)a	0.06 (0.01)a	0.06 (0.01)a	0.06 (0.01)a
CPTPP*PCA_9	0.09 (0.03)a					
USTPP*PCA_9		0.10 (0.03)a				
RCEP*PCA_9			0.00 (0.03)			
CPTPP_partner*PCA_9				−0.01 (0.04)		
USTPP_partner*PCA_9					−0.01 (0.03)	
RCEP_partner*PCA_9						0.10 (0.03)a
constant	−1.35 (0.06)a	−1.35 (0.06)a	−1.36 (0.06)a	−1.36 (0.06)a	−1.36 (0.06)a	−1.35 (0.06)a
country-pair	Yes	Yes	Yes	Yes	Yes	Yes
country_year	Yes	Yes	Yes	Yes	Yes	Yes
No. obs	86,080	86,080	86,080	86,080	86,080	86,080
log-likelihood	−39,420	−39,419	−39,426	−39,426	−39,426	−39,420

Source: Author's calculation.

Note: Standard errors are reported in parentheses. "a" and "b" denote significance at the 1% and 5% levels, respectively.

D. Robustness Checks

We now test the sensitivity and robustness of our baseline estimates. We considered the robustness of the results to alternative measures of global value chains. We also employed the conventional approach to deal with the panel data analysis for generalized least-squares (GLS) instead of the Poisson pseudo-maximum likelihood methodology used in the previous sections.

For the alternative measures of global value chains, we used the logs of domestic value added in imports (*imp_dva*) and the bilateral gross imports of intermediate goods (*imp_int*) as the proxies of global value chains in Models 1 through 6 in Table 8.

In Columns (1) through (6) of Table 8, the parameter estimates for

Table 8
Robustness Checks using GLS Methodology

Dependent Variable	Log(imp_dva)			Log(imp_int)		
RTA	–0.23 (0.03)a		–0.23 (0.03)a	0.23 (0.02)a		0.23 (0.02)a
BIT		0.29 (0.02)a	0.29 (0.02)a		0.30 (0.02)a	0.30 (0.09)a
PCA_9	0.56 (0.07)a	0.35 (0.06)a	0.51 (0.07)a	0.14 (0.05)a	0.31 (0.04)a	0.11 (0.05)b
Asia*PCA_9	–0.36 (0.07)a	–0.14 (0.06)b	–0.31 (0.07)a	–0.03 (0.05)	–0.20 (0.05)a	0.01 (0.05)
America*PCA_9	–0.42 (0.07)a	–0.21 (0.07)a	–0.37 (0.07)a	–0.09 (0.05)	–0.26 (0.05)a	–0.06 (0.05)
Europe*PCA_9	–0.41 (0.07)a	–0.20 (0.06)a	–0.36 (0.07)a	–0.01 (0.05)	–0.17 (0.04)a	0.03 (0.05)
constant	–1.19 (0.11)a	–1.28 (0.11)a	–1.28 (0.11)a	2.96 (0.10)a	2.89 (0.10)a	2.89 (0.10)a
country-pair	Yes	Yes	Yes	Yes	Yes	Yes
country_year	Yes	Yes	Yes	Yes	Yes	Yes
No. obs	44,118	44,118	44,118	82,143	82,143	82,143
R-square	0.46	0.46	0.46	0.19	0.19	0.20

Source: Author's calculation.

Note: Standard errors are reported in parentheses. "a" and "b" denote significance at the 1% and 5% level, respectively.

PCA_9 are positive and statistically significant, which means that deep RTAs have positive impacts on domestic value added in imports and bilateral gross imports of intermediate goods. The results reveal the statistically significant impacts of deep RTA in Asia, America, and Europe on global value chains. However, the magnitude of parameter estimates differs depending on the region.

V. Summary and Conclusion

This study aimed to test if deep regional integration contributes to the organization of global value chains centered around regional clusters including Asia, Europe, and America. We estimated the impacts of deep regional integration on global value chains by region and investigated the implications of mega FTAs for global value chains by scenario. We used data on TiVA and also global value chain participation indexes that reflect the global value chains better than the domestic value added of goods and services exports.

The empirical results obtained by a Poisson pseudo-maximum likelihood methodology indicate that the RTA member countries export more intermediate goods to RTA partner countries if an RTA contains deeper provisions. The parameter estimates are positive and statistically significant when we estimated the effect of the depth of RTA on the forward and backward participation indexes. Thus, deep regional integration contributes to the organization of global value chains centered around the regional clusters.[16]

Specifically, our results indicate that a deep RTA has heterogeneous effects on global value chains depending on the regional clusters. Baldwin and Lopez-Gonzalez (2015) claimed that the so-called Factory Asia is much closer to a network rather than the hub-and-spoke pattern observed in Factory North America and Factory Europe, as processing often includes stops in multiple nations.[17] According to our results, Asia

[16] Swati (2018) noted that developed countries benefited from opening their economies as compared with emerging countries. Refer to Swati (2018), p.87.

[17] Baldwin and Lopez-Gonzalez (2015) indicated that "Factory North America is a simple hub-and-spoke system because importing to export is mostly bilateral." Their work also revealed that "Factory Europe is similar but complicated by the proximity of three other high-technology nations near the hub nation (Germany)." Refer to Baldwin and Lopez-Gonzalez (2015), pp.1711–1712.

centered around China imports more intermediate goods than Europe and America because it assembles the parts and components to export the final goods to foreign countries. RTA member countries tend to import more intermediate goods from Europe than Asia and America.

Finally, Orefice and Rocha (2014) and Antras and Staiger (2012) revealed that a causal relationship running from global value chains to RTAs holds because the rise of global value chains makes it increasingly imperative to solve trade-related issues. Accordingly, future studies must deal with the feedback effects between global value chains and RTAs and focus on contentious content, such as IPR and TBT.

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Appendix

Country and Industry Classification

Abbr.	Description	Abbr.	Description	2016 Edition	2018 Edition	Industry description
AUS	Australia	GBR	United Kingdom	C01T05	D01T03	Agriculture, hunting, forestry, and fishing
AUT	Austria	USA	United States	C10T14	D05T09	Mining and quarrying
BEL	Belgium	ARG	Argentina	C15T16	D10T12	Food products, beverages, and tobacco
CAN	Canada	BRA	Brazil	C17T19	D13T15	Textiles, textile products, leather, and footwear
CHL	Chile	BRN	Brunei Darussalam	C20	D16	Wood and products of wood and cork
CZE	Czech Republic	BGR	Bulgaria	C21	D17	Pulp, paper, paper products, printing, and publishing
DNK	Denmark	KHM	Cambodia	C23	D19	Coke, refined petroleum products, and nuclear fuel
EST	Estonia	CHN	China	C24	D20	Chemicals and chemical products
FIN	Finland	TWN	Chinese Taipei	C25	D22	Rubber and plastics products
FRA	France	COL	Columbia	C26	D23	Other non-metallic mineral products
DEU	Germany	CRI	Costa Rica	C27	D24	Basic metals

Abbr.	Description	Abbr.	Description	2016 Edition	2018 Edition	Industry description
GRC	Greece	HRV	Croatia	C28	D25	Fabricated metal products
HUN	Hungary	CYP	Cyprus	C30T33X	D26	Computer, electronic, and optical equipment
ISL	Iceland	HKG	Hong Kong	C31	D27	Electrical machinery and apparatus, nec
IRL	Ireland	IND	India	C29	D28	Machinery and equipment, nec
ISR	Israel	IDN	Indonesia	C34	D29	Motor vehicles, trailers, and semi-trailers
ITA	Italy	KAZ	Kazakhstan	C35	D30	Other transport equipment
JPN	Japan	MYS	Malaysia	C36T37	D31T33	Manufacturing nec; recycling
KOR	Korea	MLT	Malta	C40T41	D35T39	Electricity, gas, and water supply
LVA	Latvia	MAR	Morocco	C45	D41	Construction
LTU	Lithuania	PER	Peru	C50T52	D45T47	Wholesale and retail trade; repairs
LUX	Luxembourg	PHL	Philippines	C60T63	D49T53	Transport and storage
MEX	Mexico	ROU	Romania	C55	D55	Hotels and restaurants
NLD	Netherlands	RUS	Russia	C71	D58	Renting of machinery and equipment
NZL	New Zealand	SAU	Saudi Arabia	C64	D61	Post and telecommunications
NOR	Norway	SGP	Singapore	C72	D62	Computer and related activities
POL	Poland	ZAF	South Africa	C65T67	D64T66	Financial intermediation
PRT	Portugal	THA	Thailand	C70	D68	Real estate activities
SVK	Slovak Republic	TUN	Tunisia	C73	D69	R&D and other business activities
SVN	Slovenia	VNM	Vietnam	C75	D84	Public admin. and defense; compulsory social security
ESP	Spain	-	-	C80	D85	Education
SWE	Sweden	-	-	C85	D86	Health and social work
CHE	Switzerland	-	-	C90T93	D90T96	Other community, social, and personal services
TUR	Turkey	-	-	C95	D97	Private households with employed persons

Source: OECD, Inter-Country Input-Output (ICIO) Tables, 2018 edition. https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm (accessed April 9, 2019)

Note: Asia includes CHN, TWN, HKG, JPN, KOR, IND, AUS, NZL, BRN, IDN, KHM, MYS, PHL, SGP, THA, and VNM. Europe includes CHE, NOR, ISL, and the 28 EU member countries. America includes the USA, MEX, CAN, ARG, BRA, CHL, COL, CRI, and PER.

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